NEW METHODOLOGIES OF TEACHING BASED ON AUGMENTED REALITY

M.A. López-Peral, E. García-González, M.D. Andújar-Montoya

University of Alicante (SPAIN)

Abstract

Augmented Reality (AR) is a new educational approach that modifies how the student receives the information. The learning becomes totally dynamic. Augmented Reality is totally useful for the practical part of the subjects. Especially in technical Degrees. In the first year of these Degrees there are very specific subjects that are totally new for the students. The subject "Fundamentals of Construction" of the first year of the Degree in Technical Architecture is one of them. Augmented Reality is a technology that combines digital information (virtual) and physical information (material), in real time thanks to different technological devices (tablets, smartphones, glasses...). The use of new technologies in the classroom is a great success. The current student profile is familiar with all technical advances. This reality is the way of change in Spanish higher education. The lecture class should not disappear because it is demanded by the student, but now it is not the only way of learning and it is not the most important as it has been demonstrated in recent years. This paper is related to the Augmented Reality (AR) as a resource to take into account in the teaching of building structures. Students have better space vision with Augmented Reality and for that reason it is used as a new resource in the subject “Fundamentals of Construction”.

Keywords: Augmented Reality, Virtual Reality, Digital Information.

1 INTRODUCTION

Today university students use the new technologies in their learning with great success. The university teaching change is motivated by this situation.

The lecture class should not disappear. This kind of class is still useful and is even demanded by the students. It is important to realize that this is not the only or the most important way in the learning process.

New technologies, for instance Augmented Reality, are assumed to be very popular in the classroom. This paper is about how to introduce the Augmented Reality (AR) in the compulsory subject "Fundamentals of Construction" of the first year of the Degree in Technical Architecture at the University of Alicante. This subject has a very important practical part. At the end of the semester, the students must be able to solve simple constructive details in 2 dimensions (2D) about the main units of the subject, for example, they must know how to solve constructive details about foundations, structures, roofs...

The main difficulty is to obtain a real vision in three dimensions from a drawing in two dimensions. The Augmented Reality is a great help in this problem. This technology offers a spacial vision from a physical reality such as traditional notes or textbooks.

This methodological change requires an effort of all - teachers and students - in the transformation of contents. Therefore, its implementation will be progressive in successive academic courses.

First of all, it is important to note that Augmented Reality (AR) is not the same as Virtual Reality (VR). VR is a totally artificial digital environment created *ad hoc* by computers. VR immerses students in a non-existent world while AR combines the real and the virtual. Thus, the AR is a technology that allows the combination of digital information and physical information in real time through different technological devices (tablet, smartphones, glasses...) A new reality is created, where both real and virtual information play a significant role, giving rise to a new communication scenography [1]. According to the digital content linked to the object created with AR, you can find mixed realities that integrate 3D, video, text, images and audio. The main characteristics of the Augmented Reality are shown below [2], Fig. 1.

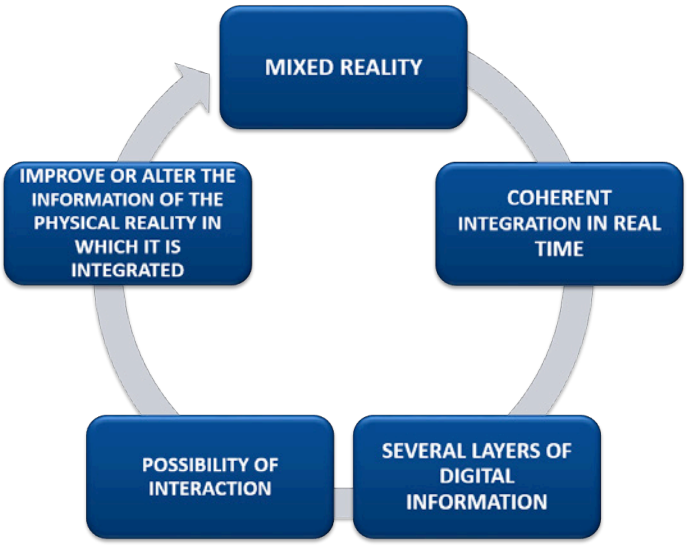

Figure 1. Distinctive features of Augmented Reality.

1.1 Literature Review

Several Horizon Reports have presented the AR as an emerging technology in the education sector that will have a significative presence at Universities in a term of 3 to 5 years [3] [4]. Detailed studies have been written about the possibilities and application elements of the AR [5]. According to the review of these publications, the incidence of AR in education is a real fact, especially in science, humanities and arts. However, in engineering and architecture, the research about the advantages about the learning using AR is being less explored.

The student motivation is achieved with the use of the AR in Higher Education, especially in the first years of technical degrees, with practical subjects. If the possibilities of AR are applied to the traditional method of study (notes, textbooks, etc...) a better learning is achieved, as well as the collaboration of the student in the subject.

There is a wide variety of AR mobile APPs in different systems (Android, iOS...). After studying the advantages and disadvantages, the *Blippar App* has been chosen for this experience, Fig. 2, because this application recognizes objects and offers AR information about them.

This experience, will consist in the application of the AR not only with 3D models or with real photos of constructive details but also with videos and audios.

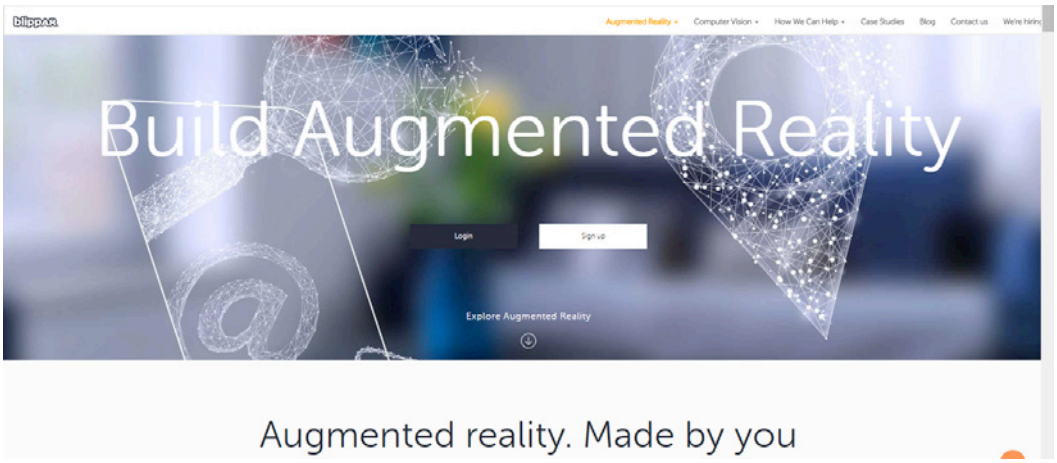

Figure 2. "Blippar App."

1.2 Purpose

The main objective is to analyze the deficiencies detected after years of experience in the subject, in order to achieve 3D visualization of constructive details made in 2D. It is proposed the development of different objects of learning in AR referring to different construction details, in order to understand the main details of initiation in the construction sector with a real representation of these solutions.

2 METHODOLOGY

The European Higher Education Area (EHEA), also known as the Bologna Declaration, aims to facilitate the development of educational changes to improve the teacher innovation [6]. This new experience is presented for the subject "Fundamentals of construction" with two differentiated action steps about content and application times, Fig. 3.

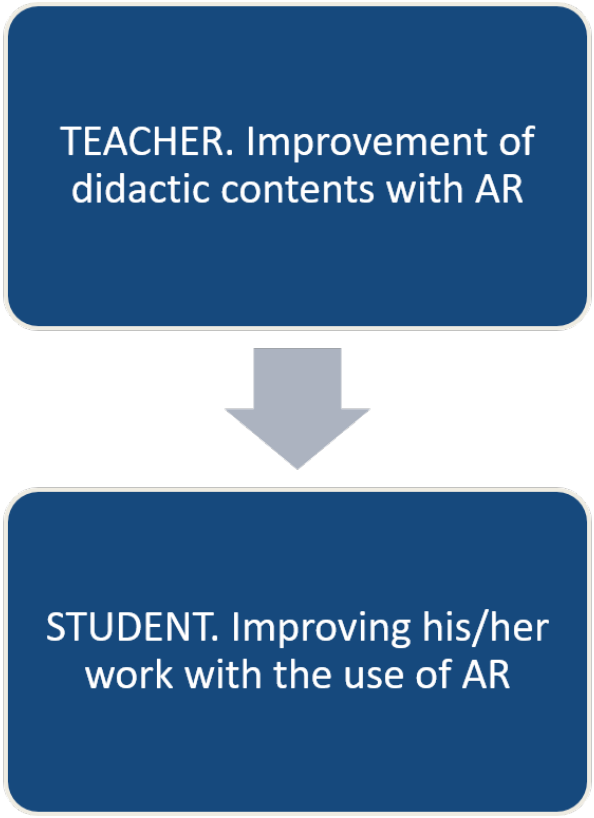

Figure 3. Order of actions in the introduction of AR content in the subject.

The first stage is to introduce the AR in the theory notes of the subject and in next years, the student - with a basic knowledge - will be able to create his applications with Augmented Reality. This paper is about the first stage described. The main methodological actions followed for the transformation of didactic documents are listed below.

- **First. AR Implementation by the teacher in the teaching resources.** In the theoretical part of the subject the introduction of the AR makes possible the explanation with the visualization in real time of videos and / or explanatory audios. As a result, the student is more receptive and there is a constant feedback between the explanation and the real application. This new perspective implies the modification of the powerpoints, and the publications of the subject. Maybe in the practical part of the subject, the AR will be more useful. The subject deals with the basic principles of construction, which will be extended in the successive years. The student must do several compulsory practices, Fig. 4.

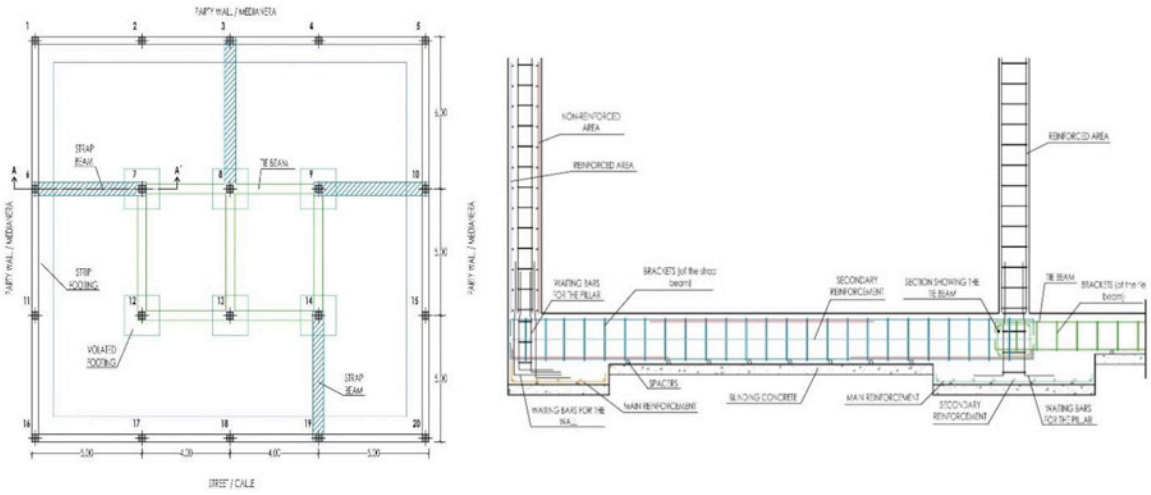

Figure 4. 2D foundation details. Plant and section. Traditional system for teaching details.

First, the teacher has made a list of the main constructive details that the student should know at the end of the semester. Second, it must be done the 3D details model, in order to achieve its animation later, Fig. 5. Each of the details in 3D will have buttons that will allow the student to visualize images about different materials used with an explanatory audio. This actuation with be done with their mobile or tablet, in an easy way without interrupting their study rhythm to connect.

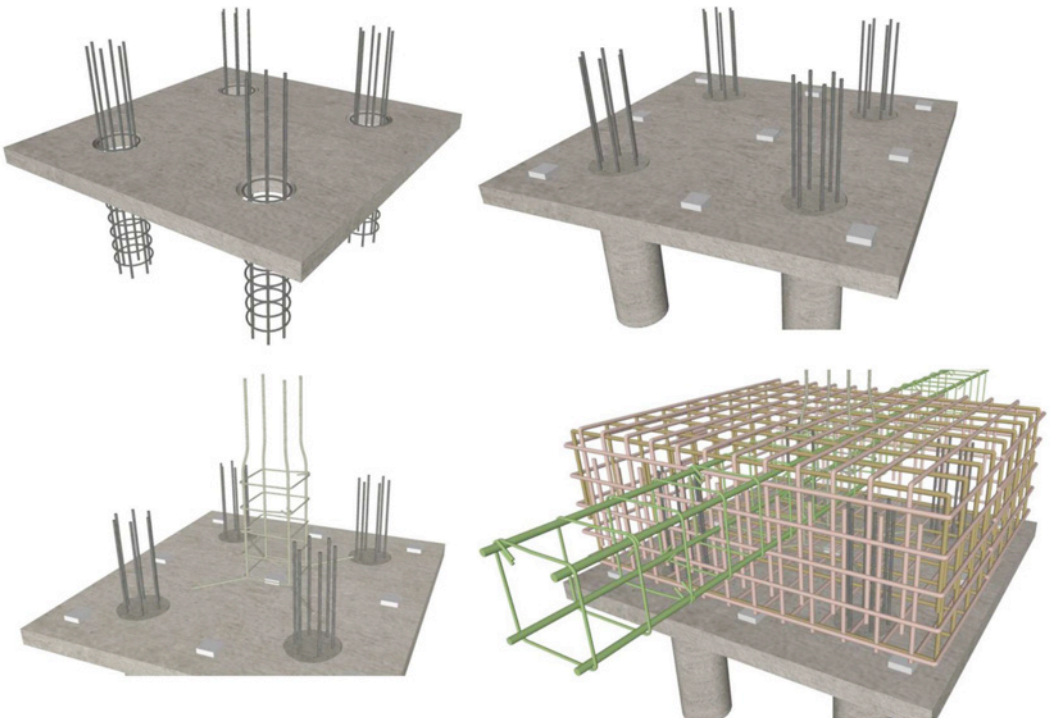

Figure 5. 3D detail of the different construction stages of a foundation, made by AR (in tests).

- **Future actions: Student formation in AR**. In the next years, the AR will be part of the student's learning in the subject. For this reason, the course context must be reorganized and the changes must be written in the teaching guides. The application to be taught will be "*Blippar*", more specifically the free version, "*Blippbuilder*", Fig. 6, being necessary to register at https://accounts.blippar.com/signup/free.

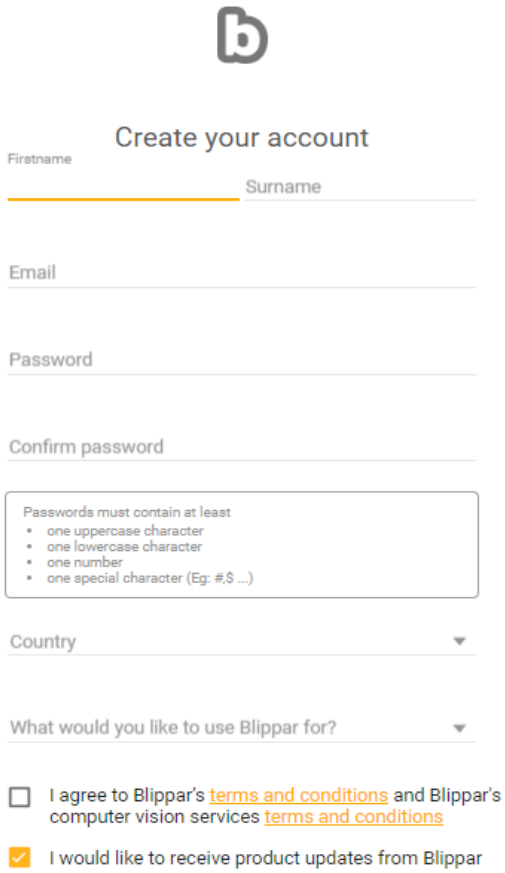

Figure 6. Web environment of registration in the application. https://accounts.blippar.com/signup/free

Before the implementation of the AR, several Workshops have been carried out as a part of the continuous evaluation of the subject. The students have to explain to their classmates a topic related to the subject, by a poster in A2 size. RA in this activity offers a new way of knowledge, in addition to improving the involvement of the student in the subject, in order to participate in public.

As a summary, the main objectives to be achieved in this new teaching-learning method are shown in Fig. 7.

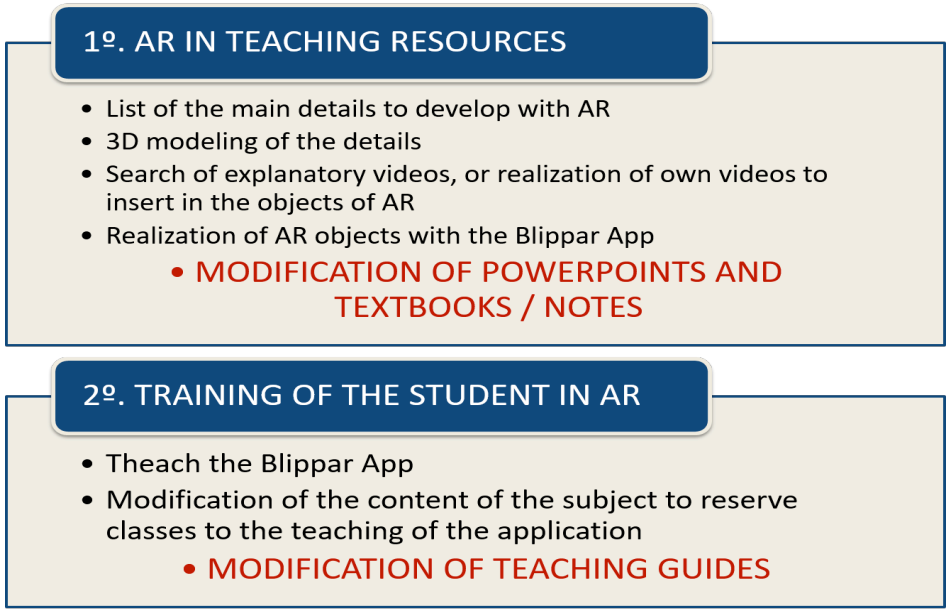

Figure 7. Summary of implementation stages of the AR in the subject.

3 RESULTS

3.1 Teaching experiences planned

The new methodology must be applied from the first years of the Degree. The subject "Fundamentals of Construction" will be the first to adapt to the new existing paradigm for the next academic year. The goal is to adapt the new existing technologies to university teaching and also to improve student motivation, participation and learning, because with traditional teaching methods, good academic results are not obtained [7].

It is planned to continue making the posters described above as part of the continuous evaluation. At the beginning, only QR codes will be required to develop part of the information described in posters. In previous years, with this activity it has been demonstrated that collaborative work is fostered, an aptitude of maximum relevance for their professional future. The teacher will teach the interface *Blippar* as a part of this workshop, explaining the basic concepts of this application, but the hard work must be made by the student who must complete their training with resources available technologies. Many future actions will be done, because the use of the AR is available for all the subjects of the future courses of the Degree. AR is the perfect complement for the explanations of all the subjects: structural calculations, economic management: measurements, budgets and property surveys or construction equipment, installation and auxiliary resources, for example.

Before these future actions, it will be very important to know if this methodology is accepted by the students. The teachers will deliver to the students a questionaires with several questions about the development of this new way of study. They answers will be individually and anonymously. The activities related to AR will increase in the future years. With the analysis of the surveys, the continuous improvement of this activity will be carried out.

4 CONCLUSIONS

The adoption of new methodologies according to the new technologies, is looking for two main purposes. On the one hand, the obvious and necessary constant improvement of the educational system and on the other hand improve the student's motivation, participation and learning, because with a traditional teaching methods they does not obtain good academic results [8].

The practical part of the subject allows to adopt the AR with multiple solutions. Workshops have already be done in which students have to solve different parts of a simple construction project or develop a specific topic of the subject. These workshops have been experimented with other emerging methodologies, for example BIM technology (Building Information Modeling), with a great acceptance by the students, so the knowledge with the use of AR will have a successful reception.

In general, students have high levels of satisfaction working with learning objects made with new technologies. Teamwork is encouraged, and academic results improve in relation to traditional teaching systems. The learning resources created with AR provide a more real knowledge of the different solutions of constructive details.

Finally, it should be noted that at the beginning of this new experience, the student may find himself a little disoriented. The teacher has the responsibility of achieving a gradual normalization. The student does not have to perceive the use of new technologies as a difficulty added before their profesional work, but as a possibility to achieve the excellence in their learning.

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